Bonneville Power Administration
Fish and Wildlife Program FY99 Proposal Form

Section 1. General administrative information

Monitoring Smolt Migration of Wild Snake River Spring/Summer Chinook

Bonneville project number, if an ongoing project 9102800

Business name of agency, institution or organization requesting funding
National Marine Fisheries Service

Business acronym (if appropriate) NMFS/NWFSC

Proposal contact person or principal investigator:

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Subcontractors.

Organization	Mailing Address	City, ST Zip	Contact Name
N/A			

NPPC Program Measure Number(s) which this project addresses.
5.9A.1; and 5.8A.8 (partially)

NMFS Biological Opinion Number(s) which this project addresses.

NMFS BO RPA 13a and 13f

Other planning document references.

2.1.d.5 of NMFS Snake River Salmon Recovery Plan.

Subbasin.

Salmon River Drainage of Idaho

Short description.

Collect time series information to examine migrational characteristics of wild ESA-listed Snake River chinook salmon stocks. Mark wild spring/summer chinook salmon parr with PIT-tags; intercept and decode tagged smolts as they pass Snake and Columbia River dams. Monitor environmental conditions within natal streams and determine how they effect wild parr and smolt movement.

Section 2. Key words

Mark	Programmatic Categories	Mark	Activities	Mark	Project Types
X	Anadromous fish		Construction		Watershed
	Resident fish		O & M	+	Biodiversity/genetics
	Wildlife		Production		Population dynamics
	Oceans/estuaries	+	Research	+	Ecosystems
	Climate	X	Monitoring/eval.	X	Flow/survival
	Other		Resource mgmt		Fish disease
			Planning/admin.		Supplementation
			Enforcement		Wildlife habitat enhancement/restoration
			Acquisitions		

Other keywords.

Stock timing, Life history

Section 3. Relationships to other Bonneville projects

Project #	Project title/description	Nature of relationship
9302900	Survival Estimation for Dam/Reservoir Passage	9102800 fish used in survival estimates at downstream dams.
8909800	Idaho Supplementation Studies	9102800 information used by this study in certain streams for background information for supplementation.
9202604	Spring Chinook Salmon Early Life	9102800 information includes some

	History/ODFW	Oregon streams.
9600600	PATH	9102800 provides critical and empirical data used for modeling survival through the hydrosystem in PATH.

Section 4. Objectives, tasks and schedules

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Gather data related to smolt migrational timings of individual and combined populations of wild fish.	a	Collect and PIT tag wild Snake River spring/summer chinook salmon parr during late summer each year. Download/analyze PIT-tag detection information on these fish from PSMFC database each spring and summer.
2	Gather data on environmental conditions within streams where PIT-tagged wild parr reside.	b	Service and download/analyze data from environmental monitors every 4 months. Communicate analyzed data on Internet.
3	Provide timing information on a yearly basis and determine differences between years related to seasonal climatic and environmental conditions within the streams.	c	Analyze all collected data and provide quarterly and annual reports.

Objective schedules and costs

Objective #	Start Date mm/yyyy	End Date mm/yyyy	Cost %
1	6/1991	12/2005	50%
2	6/1996	12/2005	25%
3	6/1991	12/2005	25%

Schedule constraints.

Acquisition of State of Idaho Collectors Permits and/or ESA-Permits may affect schedules. A major milestone occurred in 1997 when this projected shifted from a 6-year study to an ongoing study, due to the importance of obtaining migrational timing information for wild fish stocks.

Completion date. 2005

Section 5. Budget

FY99 budget by line item

Item	**Note**	**FY99**
Personnel		$127.7K
Fringe benefits		25.1K
Supplies, materials, non-expendable property		111.7K
Operations & maintenance		14.4K
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		
PIT tags	# of tags: 26,000	75.4K
Travel		47.4K
Indirect costs		55.8K
Subcontracts		
Other		
TOTAL		$457.5K*

*FY99 budget is larger than previous and future years because: 1) probably many more parr will be PIT tagged than other years (similar to 1994), 2) purchase of electronic gear for PIT tagging with the new PIT tag, and 3) purchase of new environmental monitors.

Outyear costs

Outyear costs	**FY2000**	**FY01**	**FY02**	**FY03**
Total budget	325.0K	325.0K	350.0K	350.0K
O&M as % of total	4.4	4.4	4.1	4.10

Section 6. Abstract

The overall project goals are to: 1) characterize the migration timing of selected wild stocks of Snake River spring/summer chinook salmon smolts at dams on the Snake and Columbia Rivers, 2) determine if consistent migration patterns are apparent, and 3) determine what environmental factors influence migration timing. The FWP states that a monitoring program will provide information on the migrational characteristics of various stocks of salmon and steelhead within the Columbia Basin and further urges conservation of genetic diversity, which will only be possible if wild stocks are preserved. Wild chinook salmon parr are PIT tagged in their natal streams in late summer, and smolts are

monitored at downstream dams the following spring and summer. Migrational timing patterns of individual and combined populations are mapped over time and examined for relationships with various environmental and climatic conditions.

Section 7. Project description

a. Technical and/or scientific background.

The Snake River drainage once produced a relatively stable population of spring and summer chinook salmon. Raymond (1988) estimated that prior to 1970, combined populations of wild spring and summer chinook salmon smolts arriving annually at Ice Harbor Dam ranged from 1.3 to 2.0 million. With virtually no programs in place for their protection during dam passages, these wild populations produced adult returns ranging from 50,000 to 79,000 fish, with an average return rate of 4.4%.

However, major problems developed during the 1970s that severely impacted these wild populations during their migrations through the hydroelectric complex. In the early 1970s, three additional dams were completed on the lower Snake River. Concomitantly, gas supersaturation caused by spilling excess water during average-to-high flows was identified as a major cause of mortality affecting both adult and juvenile migrants (Ebel et al. 1975). In contrast, severe droughts in the Snake River during 1973 and 1977 were associated with catastrophic losses of smolts, although the losses were probably related more to poor passage conditions at dams than to low flows. Moreover, during the latter part of the decade, mortalities and injuries associated with certain components of newly installed collection and bypass facilities at Lower Granite, Little Goose, and McNary Dams likely decreased survival.

The spawning escapement trends from 1960 through the early 1980s chronicle the rapid decline in wild population (White and Cochnauer, in press). During 1960-70, redd counts in the Middle Fork of the Salmon River index areas averaged 1,603 redds (1,026-2,180), but from 1971 to 1978, the counts dropped to an average of 683 redds (221-1,348). During the next 6 years (1979-84), counts plummeted to an average of 142 redds (38-195). A once-viable population of wild fish appeared to be nearing extinction. However, the severely reduced spawning escapements in the early 1980s produced substantial increases in spawning indices in recent years. From 1985 through 1988, redd counts in the Middle Fork of the Salmon River averaged 533 redds (350-972): a four-fold increase over the previous 6-year period. Wild stocks are clearly highly resilient, and under appropriate conditions, possess the potential for recovery.

To some extent, downstream movements of wild juvenile spring and summer chinook salmon from natal areas occur during most of the year except mid-winter (Edmundson et al. 1968, Durkin et al. 1970, Krcma and Raleigh 1970, Bjornn 1971, Everest and Chapman 1972, Raymond 1979, Sekulich 1980, Lindsay et al. 1986). By far the largest downstream displacements occur in fall (0 age) and spring (1+ age). The magnitudes of the fall migrations vary annually by stream and are influenced by prevailing environmental conditions and cover availability (Bjornn 1971, Raymond 1979, Sekulich 1980).

The fall migrations do not include all individuals of a particular stream population and are limited to movements into larger downstream tributaries probably for overwintering. The spring movements are associated with smoltification and downstream migration to the sea. Regardless of location in fresh water, all yearling chinook salmon follow this life history pattern except for small numbers of precocious males (Bjornn 1971). If flows are adequate, these migrations culminate in all fish moving into the sea.

Before 1989, data on the timing of individual populations of wild fish as they passed through the lower Snake River on their way to the sea were limited. Raymond (1979) reported on the timing of wild smolts arriving at Ice Harbor Dam from 1964 through 1969. In that study, the composite population (mostly wild) arrived at the dam in early April and was usually present until mid-June. Peak movements varied annually, occurring as early as 20 April and as late as 20 May. In addition, the timing of a few individual populations were reported for only 2 years, 1966 and 1967. In 1966, Raymond found the earliest arriving fish were from Eagle Creek and the Imnaha River in Oregon, with a median passage date of 16 April for both streams. The latest arriving fish were from the Grande Ronde and Wallowa Rivers in Oregon with median passage on 3 June for both streams. In 1967, the earliest arriving fish were from the Lemhi River in Idaho, with a median passage date of 21 April, while fish from a nearby stream, the East Fork of the Salmon River, arrived last, with a median passage date of 19 May. Lindsay et al. (1986) found that wild smolts from the John Day River moved past John Day Dam on the Columbia River between mid-April and early June from 1979 through 1984. However, sample rates were extremely low at the dam, averaging 0 to 6 fish per year.

A detailed review of Raymond's unpublished field notes and data reveals that his results do not provide the scope or precision that are now required for making decisions on behalf of these fish during their smolt migrations through the hydroelectric complex. For logistical reasons, the timing of populations from individual streams or reaches received little attention. Moreover, by today's standards, the methods used were primitive. Various forms of thermal marks including hot brands, alcohol and dry ice, and liquid nitrogen were used to mark very small parr in fall. Nearly all of these marks would have been virtually undetectable, much less identifiable, the following spring.

Marked fish were not representative of the entire population in any particular stream, as nearly all marking was on parr caught in box traps in fall, and marking of fish not migrating at this time was limited to a few individuals in a few streams. Only fish greater than 70-mm fork length were marked. This likely would have excluded from the study nearly half of the fish sampled in all streams. In many cases, release numbers were low. In all cases, recoveries of marked fish at Ice Harbor Dam were low, usually in the range of 0-10 fish.

Before 1992, fisheries management relied on branded hatchery fish, index counts at traps and dams, and flow patterns for information to guide decisions on dam operation and when to use water set aside for fish. In 1992, a more complete approach integrated PIT-tag information on passage of several wild spring and summer chinook salmon stocks through Lower Granite Dam. We are now moving closer to some specific goals of the Columbia River Basin Fish and Wildlife Program of the Pacific Northwest Electric Power Planning Council and Conservation Act (1980). Section 304(d) of this program states that: "The monitoring program will provide information on the migrational characteristics of the various stocks of salmon and steelhead within the Columbia Basin." Further, Section 201(b) urges conservation of genetic diversity. This will only occur if wild stocks are preserved. In addition, Section 5.9A.1 of the 1994 Fish and Wildlife Program states that field monitoring of smolt movement will be used to determine the best timing for water storage releases, and Section 5.8A.8 states that continued research is needed on survival of juvenile wild fish before they reach the first dam, with special attention to water quantity, quality, and several other factors. Clearly, the advent of PIT-tag technology has provided the opportunity to precisely track the smolt migrations of many stocks as they pass through river traps and the hydroelectric complex on their way to the ocean.

The National Marine Fisheries Service (NMFS) began a cooperative study with the U.S. Army Corps of Engineers (COE) in 1988 to PIT tag wild spring and summer chinook salmon parr for transportation research. This project continued through mid-1991, with outmigrating smolts monitored during spring and summer 1989-91 as they passed Lower Granite, Little Goose, and McNary Dams (Matthews et al. 1990, 1992; Achord et al. 1992, 1996b). Information from this study demonstrated that timing of various wild stocks through Lower Granite Dam differed among streams and also differed from patterns for hatchery-reared fish. Generally, the outmigrations of wild spring chinook salmon were later and more protracted than for their hatchery-reared counterparts, and they also exhibited variable outmigration timing patterns over the 3 years. Conversely, the outmigrations of wild summer chinook salmon were earlier and more protracted than for their hatchery counterparts.

b. Proposal objectives.

Overall Study Objective: Characterize the outmigration timing of wild Snake River spring/summer chinook salmon smolts at Lower Granite Dam over a period of years.

1) Null Hypothesis (Ho): Run-time distributions at Lower Granite Dam are not significantly different within years among wild smolt populations in the Snake River drainage.

Corollary: If null hypothesis is rejected, it is highly likely that run-timing to Lower Granite dam is different among wild populations within years in the Snake River and that these differences may be influenced by several environmental factors and/or genetics.

Criteria for rejecting Ho: The null hypothesis will be rejected if run-timing is significantly different among populations by re-sampling methods. Significance will be set at ($P<0.05$).

2) Null Hypothesis (Ho): Run-time distributions for fish from individual streams or tributaries at Lower Granite Dam are not significantly different among years.

Corollary: If the null hypothesis is rejected, it is highly likely that run-timing of fish from individual streams or tributaries is different among years and that these differences may be influenced by other factors such as temperature or flow.

Criteria for rejecting Ho: The null hypothesis will be rejected if run-timing of fish from individual streams is different among years by re-sampling methods. Significance will be set at ($P<0.05$).

After at least 5 years of data, we will analyze arrival timing distributions at Lower Granite Dam for fish from individual streams as well as combined streams between years. We will also continue to analyze arrival timing distributions for fish from individual streams within years. One method used for statistically comparing these distributions is the Student-Newmann-Keuls multiple comparison method. If timing differences are found, we will attempt to relate environmental conditions within the streams, as well as annual climatic conditions, to observed timing differences.

More detailed information and results from this project can be found in the following list of reports and publication:

Reports:
Annual Report 1992 DOE/BP-18800-1 September 1994
Annual Report 1993 DOE/BP-18800-2 January 1995
Annual Report 1994 DOE/BP-18800-3 September 1995
Annual Report 1995 DOE/BP-18800-4 September 1996
Annual Report 1996 DOE/BP-18800-5 July 1997
Publication:

Achord, S., G. M. Matthews, O. W. Johnson, and D. M. Marsh. 1996. Use of passive integrated transponder (PIT) tags to monitor migration timing of Snake River chinook salmon smolts. N. Amer. J. Fish. Manage. 16:302-313.

c. Rationale and significance to Regional Programs.

Background rational for this ongoing monitoring project including objectives and hypotheses are presented above under 7a and 7b. The continuance of wild fish monitoring is a stated goal of the FWP.

IDFG project 8909800 uses timing information from several wild stocks for background information on continued supplementation studies and project 9107300 is an intense study in the upper Salmon River on production in adjacent streams to streams involved in 9102800. Several other existing BPA projects by IDFG, NPT, SBT, and ODFW monitor wild fish movement in Lake Creek, South Fork Salmon River, Marsh Creek, several streams in northeast Oregon, and the upper Salmon River by fish traps. Since we monitor many of these same streams, we work closely with each agency on summer tagging schedule coordination, data exchange, and environmental monitoring in conjunction with several traps. Together, we hope to detail movements of wild fish during parr-to-smolt development in several different streams and relate these movements to environmental conditions within the streams.

d. Project history

The present study began with the 1992 migration of wild chinook salmon smolts (Achord et al. 1994). Warm weather and high water temperatures in late winter and spring appeared to elicit an early migration timing for all wild smolts in 1992. The migration timing of wild spring chinook salmon smolts was earlier in 1992 than in the previous 3 years. Also, most wild summer chinook salmon smolts migrated earlier than wild spring chinook salmon smolts. However, as was observed during previous years, all wild stocks exhibited protracted and variable migration timing at Lower Granite Dam.

In 1993, cold weather and low water temperatures from late winter to early summer appeared to elicit a late migration timing; however, high flows during the third week of May moved a large portion of wild spring/summer chinook salmon through the dams (Achord et al. 1995a). As observed in previous years, wild stocks exhibited variable migration timing at Lower Granite Dam; however, the middle 80% passage time of wild fish stocks at the dam was more compressed in 1993 than in earlier years.

In 1994, migration timing of wild spring/summer chinook salmon smolts at Lower Granite Dam was similar to timing in 1990 and 1992, with peak passage in all 3 years occurring in April; however, peak detections of fish from individual streams in 1994 occurred from late April to late May (Achord et al. 1995b). As observed in 1990 and 1992, 1994 was also warm during late winter and spring.

Before 1995, we observed a 2-week shift in timing of wild fish at Lower Granite Dam between relatively warm and relatively cold years. In the cold years of 1989, 1991, and 1993, 50% of all wild fish passed the dam by mid-May, while 90% passed by mid-June (except in 1993, when high flows moved 90% through the dam by the end of May). In the warm years of 1990, 1992, and 1994, 50% of all wild fish passed this dam from 29 April to 4 May, and 90% passed by the end of May. In 1995, we experienced intermediate weather conditions in late winter and early spring (compared to the previous 6 years) and observed intermediate passage timing at the dam, with 50 and 90% passage occurring on 9 May and 5 June, respectively (Achord et al. 1996a). Sustained high flows from mid-May to early June in that year moved the later half of the wild fish migration through the dam at a more uniform rate than in previous years, and over 90% passed by the time peak flows occurred at the dam on 6 June.

In 1996, as observed in all previous migration years from 1989 to 1995, peak detections of wild spring/summer chinook salmon smolts at Lower Granite Dam were highly variable and generally independent of river flows before about 9 May; however, in all years, peak detections of wild fish coincided with peak flow at the dam from 9 May to the end of May. In both 1995 and 1996, well over 90% of the wild fish had migrated past Lower Granite Dam by the time peak flows occurred in June. In 1989, we observed a period of peak detections of wild fish that coincided with peak flows at the dam in June (Achord et al. 1996b). These data suggest that water reserved for fish during the out-migration may benefit more wild spring/summer chinook salmon smolts if it is initiated around 9 May in most years and may be especially important in drought years.

In 1996, 50 and 90% passage dates of PIT-tagged fish from wild stocks combined (Idaho and Oregon streams) at Lower Granite Dam occurred on 3 and 22 May, respectively. However, unlike previous years, few wild fish were marked as parr in 1995 from Idaho streams; therefore, the 1996 detections at Lower Granite Dam were composed of 91% fish from Oregon streams. Therefore, we caution against comparing migration timing in 1996 to previous years, since in all previous years less than 50% of wild fish detections were from Oregon streams.

The important information generated in this study supplies managers with inseason information for decisions related to flow augmentation and dam operations including spill and transportation. It also appears that overall annual climatic variation is emerging as an important factor controlling the overall migrational timing of wild spring/summer chinook salmon smolts at Lower Granite Dam. Environmental monitoring in streams and climate monitoring is continuing, and relationships to parr and smolt movement will be developed in the future.

Project 9102800 started 1 June 1991 and continues to the present. The project has produced five annual reports, numerous progress reports, and a peer-reviewed publication (Achord 1996b).

e. Methods.

Scope

In 1999, as in previous years, we plan to continue monitoring the timing of the migrations of wild Snake River spring/summer chinook salmon smolts from individual and combined streams through traps and dams. We will also continue to monitor environmental conditions within natal streams along with recording weather data in the same areas. Timing of these fish through traps and dams will be examined for relationships to various environmental conditions within the streams and weather data.

Approach

Chinook salmon parr will be collected in 17 streams of the Salmon River drainage of Idaho in July and August of each year using backpack electrofishers and seines. All special precautions will be used during electrofishing and all personnel are highly trained. Wild spring/summer chinook salmon are used in this study. The minimum number of wild fish PIT-tagged per stream is about 1,000, the maximum about 3,000. This results in about 30-300 smolts per stream detected at Lower Granite Dam for timing purposes.

Methodology

Portable PIT-tagging stations are used for tagging fish and are designed specifically for use beside streams in the field. Station components, setup, and PIT-tagging techniques have been described by Prentice et al. (1990a, 1990b). Fish are dipped from live cages with sanctuary dip nets and poured into plastic pans containing anesthetic; after anesthetization, chinook salmon parr greater than 54 mm in fork length are PIT tagged. Fish are allowed to recover after tagging for a minimum of 0.5 hours before release into the stream at the same location where they were collected. About 10% are held in live cages for 24 hours to measure delayed mortality and tag loss. All collection and tagging activities are terminated if the stream water temperature reaches 16 degrees C. Surviving PIT-tagged wild chinook salmon smolts are subsequently detected at downstream dams the following spring and summer.

The following statistical analyses have been used in annual reports:

1) length distributions (at tagging) vs. length distributions for detected fish (at tagging)--Chi-square; 2) mean length at tagging vs. length of detected fish (at tagging), overall and during segments of the outmigration--one and two-sample Z-tests; 3) diel timing at dam fish facilities--Chi-square; 4) comparison of detection rates at dams for fish PIT tagged and released under different water temperature scenarios--two-sample Z-tests; and 5) comparison of arrival timing distributions for fish from individual streams at Lower Granite Dam--Student-Newmann-Keuls multiple comparison method.

Collection of detection information on these wild fish will continue as long as the State of Idaho issues the yearly Collectors Permit, PIT-tag monitor systems continue at the dams, and adequate numbers of parr can be PIT-tagged each year.

The project is directly related to the overall Smolt Monitoring Program as well as numerous BPA projects conducted by IDFG, ODFW, NPT, SBT, PSMFC, and other NMFS projects. Virtually every project that relies on PIT-tag monitoring of juvenile salmonids at dams and traps is related.

f. Facilities and equipment.

No special facilities are needed for this project. Existing equipment used on the project includes field vehicles, electrofishers, seines, generators, tagging stations (including all electronic components), live cages, and other miscellaneous gear.

g. g. References.

REFERENCES

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Section 8. Relationships to other projects

Besides relationships described in the table in Section 3, many other projects complement and interact with project 9102800. Project 8331900 is directly related to implementation and upgrading the PIT tag monitor systems at the dams, 8401400 with smolt monitoring, and 9202200 with wild smolt behavior and physiology. Project 8810804 uses information on wild fish detections at dams in the development of STREAMNET that is on the Internet. STREAMNET is operated by the PSMFC and is run in conjunction with the Agencies and Tribes. It draws together a myriad of information on streams within basins and sub-basins of the Columbia River system. Project 9008000 is directly needed for project 9102800 to be successful since it runs the PTAGIS database system in the Columbia Basin. Project 9403300 deals with passage information on most smolts (including wild fish) in the Basin through river traps and dams.

Conduct of project 9102800 depends on the continued issuance of State of Idaho Collection Permits; therefore, close coordination on collection and tagging activities with the IDFG is essential. Federal ESA permits are also required.

Section 9. Key personnel

Gene Matthews
Project Manager, 0.1 FTE on project per year
Project Duties: yearly project updates for contract renewal, Progress and Annual Report Editor.

Work Experience
1987-present: Supervisory Fisheries Research Biologist. National Marine Fisheries Service. Responsible for managing the Columbia and Snake River collection and transportation research project.
1973-1986: Fisheries Research Biologist. Involved in the design and conduct of many mark/recapture studies at dams on the Columbia and Snake Rivers. Designed and conducted many studies/experiments related to disease and stress. All work conducted for National Marine Fisheries Service.

Education

1966-1970: Washington State University, B.S. 1970.

Publications/reports
Authored or co-authored 14 publications in professional journals; authored or co-authored 24 processed research reports or issue papers.

Publications
Matthews, G. M. 1979. Exposure of fingerling spring chinook salmon to mixtures of Furanace-10, Quinaldine, and MS-222. Prog. Fish.-Cult. 41(2):85-86.

Matthews, G. M., N. N. Paasch, S. Achord, K. W. McIntyre, and J. R. Harmon. 1997. A technique to minimize the adverse effects associated with handling and marking salmonid smolts. Prog. Fish.-Cult. 59(4):307-309.

Matthews, G. M., D. L. Park, S. Achord, and T. E. Ruehle. 1986. Static seawater challenge test to measure relative stress levels in spring chinook salmon smolts. Trans. Am. Fish. Soc. 115(2):236-244.

Matthews, G. M., G. A. Swan, and J. R. Smith. 1977. Improved bypass and collection system for protection of juvenile salmon and steelhead trout at Lower Granite Dam. Mar. Fish. Rev. 39(7):10-14.

Matthews, G. M., and R. S. Waples. 1991. Status review for Snake River spring and summer chinook salmon. U. S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-200, 75 p.

Stephen Achord
Principle Investigator, full-time on project (1.0 FTE)
Project Duties: field work, data collection and analysis, Progress and Annual Reports.

Work Experience

1976-present: Fisheries Research Biologist. National Marine Fisheries Service. Involved in the conduct or supervision of many mark/recapture studies at dams on the Columbia and Snake Rivers. Highly experienced in all types of fish tagging methodologies including coded-wire-tagging, freeze branding, fin clipping, and PIT-tagging.

1970-1976: Biological Aide. Idaho Department of Fish and Game. Conducted creel censuses, spawning ground surveys, and sampled fish in lakes and streams.

Education

1968-1971: Boise State University.
1971-1973: University of Idaho, B.S. 1973.

Publications/reports
Authored or co-authored 5 publications in professional journals; authored or co-authored 18 processed research reports.

Publications

Achord, S., G. M. Matthews, O. W. Johnson, and D. M. Marsh. 1996. Use of passive integrated transponder (PIT) tags to monitor migration timing of Snake River chinook salmon smolts. N. Am. J. Fish. Manage. 16:302-313.

Achord, S., J. R. Smith, and G. M. Matthews. 1984. Experimental tanker used to study transportation of juvenile salmonids. Prog. Fish.-Cult. 46(3):206-208.

Matthews, G. M., N. N. Paasch, S. Achord, K. W. McIntyre, and J. R. Harmon. 1997. A technique to minimize the adverse effects associated with handling and marking salmonid smolts. Prog. Fish. Cult. 59(4):307-309.

Matthews, G. M., D. L. Park, S. Achord, and T. E. Ruehle. 1986. Static seawater challenge test to measure relative stress levels in spring chinook salmon smolts. Trans. Am. Fish. Soc. 115(2):236-244.

Pascho, R. J., D. G. Elliott, and S. Achord. 1993. Monitoring of the in-river migration of smolts from two groups of spring chinook salmon, *Oncorhynchus tshawytscha* (Walbaum), with different profiles of *Renibacterium salmoninarum* infection. Aqua. Fish. Manage. 24:163-169.

M. Brad Eppard
Co-investigator, 0.5 FTE on project per year
Project Duties: field work, environmental monitoring database maintenance, assists in report preparation.

Work Experience

1996 - present: Research Fisheries Biologist, National Marine Fisheries Service. Project Leader for a spill efficiency study at Ice Harbor Dam using radio telemetry. Assist other project leaders in collecting and tagging juvenile salmonids, data collection and analysis, and preparing scientific reports and presentations.

1995 - 1996: Research Fisheries Biologist, Pacific States Marine Fisheries Commission. Assist project leaders of the National Marine Fisheries Service in collecting and tagging juvenile salmonids, data collection and analysis, and preparing scientific reports and presentations.

1993 - 1995: Research Fisheries Biologist, National Marine Fisheries Service. Assist project leaders in collecting and tagging juvenile salmonids, data collection and analysis, and preparing scientific reports and presentations.

Education

1986 - 1992: Central Washington University, B. S. Biology, 1992

Publications

Co-authored 11 contract research reports and 3 research proposals.

Eric E. Hockersmith
Co-investigator, 0.5 FTE on project per year
Project Duties: field work, assists in report preparation.

Work Experience

1994-present: Research Fisheries Biologist. National Marine Fisheries Service. Conduct research which includes juvenile salmonid survival studies, radio-telemetry research, and environmental monitoring. Responsibilities include project design, project operations, analyzing data, and preparing scientific reports and presentations.

1991-1994: Research Fisheries Biologist. National Marine Fisheries Service. Assistant project leader for adult salmonid radio-telemetry studies within the Yakima River Basin. Responsibilities included conducting research, analyzing data, and preparing scientific reports and presentations.

1990: Fisheries Biologist. US Forest Service. Conducted watershed and stream surveys within the Mount Hood National Forest.

1989: Fisheries Biologist. National Marine Fisheries Service. Conducted research on juvenile salmonid smolt migrations and rearing habitat utilization within the Taku River Basin in S.E. Alaska and Canada.

1988: Fisheries Biologist. US Bureau of Land Management. Conducted watershed and stream surveys for the Prineville Resource Office.

1983-1986: Fisheries Biologist. Normandeau Associates, RMC Environmental Services Division. Conducted fisheries life history studies in association with the FERC relicensing requirements for Conowingo Hydroelectric Project in Pennsylvania and Maryland .

Education

1978-82: University of New Hampshire, B.S. 1982.

Publications/reports

Authored 1 publication in a professional journal; authored or co-authored 11 processed research reports.

Publications

Hockersmith, E. E., and B. W. Peterson. 1997. Use of the global positioning system for locating radio-tagged fish from aircraft. N. Am. J. Fish. Manage. 17:457-460.

Other field personnel: Biological Technicians and Fishery Biologists, 1.2 FTE per year on project.
Duties: Fish collection and PIT tagging.

Section 10. Information/technology transfer

Information transfer will be (and is) through annual and progress reports to BPA, publications in scientific journals, and articles in newspapers and magazines including the National Geographic Magazine--July 1990. In addition, information transfer has been through oral presentations at AFS meetings, COE annual reviews of research, BPA reviews of research, and PSMFC workshops.